

Claims: What is claimed is:

1. A method of recovering data in a received signal sent in a communications media, comprising:
 - (a) estimating at least one composite channel impulse response from said received signal,
 - (b) estimating a set of noise covariances based on said composite channel impulse response,
 - (c) assigning a set of channel-tap locations by a sequential search,
 - (d) computing a set of weight coefficients for said set of channel-tap locations, and
 - (e) demodulating data in said received signal with said set of channel-tap locations and said set of weight coefficients.
2. The method of claim 1, wherein estimating said set of noise covariances based on said composite channel impulse response comprises:
 - (a) decomposing said noise variance into a one-dimensional part, a cyclostationary part, and a two-dimensional part,
 - (b) pre-computing and tabulating said one-dimensional part of said noise variance using a one-dimensional table,
 - (c) pre-computing and tabulating said cyclostationary part of said noise variance using a plurality of one-dimensional tables,
 - (d) accessing said one-dimensional tables to retrieve said one-dimensional part and said cyclostationary part of said noise covariance, and
 - (e) computing said two-dimensional part of said noise covariance.
3. The method of claim 1, wherein said sequential search comprises:
 - (a) determining a search region,
 - (b) pre-selecting a first set of channel-tap locations in said search region if said first set is predetermined to be non-empty, and
 - (c) sequentially selecting a second set of channel-tap locations in said search region to optimize a design criterion.

4. The method of claim 3, wherein said search region is a contiguous region comprising a span of the channel impulse response, a pre-channel-impulse-response section, and a post-channel-impulse-response section.
5. The method of claim 3, wherein said search region is a union of a set of path regions and a set of mirror image regions.
6. The method of claim 3, wherein said search region is a union of a set of path regions.
7. The method of claim 3, wherein pre-selecting said first set of channel-tap locations comprises choosing a number of strongest channel taps according to said composite channel impulse response, the distances among which are equal to or larger than a predetermined minimum distance.
8. The method of claim 3, wherein said design criterion is mean square error.
9. The method of claim 3, wherein said design criterion is signal-to-noise ratio.
10. The method of claim 3, wherein sequentially selecting said second set of channel-tap locations to optimize said design criterion comprises choosing a new channel-tap location that optimizes said design criterion based on a recursive evaluation that explicitly depends on:
 - (a) a set of previously evaluated functions of all previously chosen channel-tap locations, and
 - (b) a set of functions of said new channel-tap location,
 whereby said recursive evaluation can reduce the amount of computations.
11. The method of claim 10, wherein said recursive evaluation comprises:
 - (a) a function of said design criterion,
 - (b) a recursive equation of said function of said design criterion,
 - (c) a difference between two consecutive recursion values of said function of said design criterion, which is to be optimized by said new channel-tap location, and

- (d) a recursive equation of a noise variance matrix.
12. The method of claim 3, wherein sequentially selecting said second set of channel-tap locations to optimize said design criterion comprises choosing a new channel-tap location that optimizes said design criterion based on an approximate recursive evaluation that explicitly depends on:
- (a) a set of previously evaluated functions of all previously chosen channel-tap locations, and
 - (b) a set of functions of said new channel-tap location,
- whereby said approximate recursive evaluation can further reduce the amount of computations.
13. The method of claim 12, wherein said recursive evaluation comprises:
- (a) a function of said design criterion,
 - (b) a recursive equation of said function of said design criterion,
 - (c) a simplified and approximate difference between two consecutive recursion values of said function of said design criterion, which is to be optimized by said new channel-tap location, and
 - (d) a recursive equation of a noise variance matrix.
14. The method of claim 3, wherein sequentially selecting said second set of channel-tap locations to optimize said design criterion can be terminated early before a predetermined number of channel-tap locations has been selected, if the difference between the value of said design criterion before a new tap is selected and the value of said design criterion after said new tap is selected is below a predetermined threshold.
15. The method of claim 3, wherein sequentially selecting said second set of channel-tap locations to optimize said design criterion can be terminated early before a predetermined number of channel-tap locations has been selected, if a predetermined value of said design criterion has been met.

16. The method of claim 1, wherein recovering data in said received signal sent in a communications media is performed at $2\times$ oversampling.
17. A method of recovering data in a received signal sent in a communications media, comprising:
- (a) estimating at least one composite channel impulse response from said received signal,
 - (b) estimating a set of noise covariances based on said composite channel impulse responses,
 - (c) assigning a set of channel-tap locations by a heuristic search,
 - (d) computing a set of weight coefficients for said set of channel-tap locations, and
 - (e) demodulating data in said received signal with said set of channel-tap locations and said set of weight coefficients.
18. The method of claim 17, wherein said heuristic search comprises:
- (a) pre-selecting a first set of channel-tap locations, and
 - (b) selecting a second set of channel-tap locations in said search region by a heuristic search scheme.
19. The method of claim 18, wherein pre-selecting said first set of channel-tap locations comprises choosing a number of strongest channel taps according to said composite channel impulse response, the distances among which are equal to or larger than a predetermined minimum distance.
20. The method of claim 18, wherein said heuristic search scheme comprises choosing a number of channel taps, where the distance of a thus-chosen channel tap to another thus-chosen channel tap or to a pre-selected channel tap equals to the distance between a pair of pre-selected channel taps.
21. The method of claim 18, wherein said heuristic search scheme comprises choosing a number of channel taps, where the distance between a thus-chosen channel tap and a pre-selected channel tap equals to the distance between a pair of pre-selected channel taps.

22. The method of claim 18, wherein said heuristic search scheme comprises choosing a number of channel taps, where a thus-chosen channel tap is the mirror image of a pre-selected channel tap with respect to another pre-selected channel tap.
23. The method of claim 17, wherein recovering data in said received signal sent in a communications media is performed at $2\times$ oversampling.
24. A method of estimating energy levels of interference sources, comprising
- (a) computing a plurality of autocorrelation values of said received signal, wherein the number of said autocorrelation values is equal to or larger than the number of interference sources, and
 - (b) solving for said energy levels based on said plurality of the autocorrelation values.
25. A method of recovering data in a received signal sent in a communications media, comprising:
- (a) estimating at least one composite channel impulse response from said received signal,
 - (b) estimating a set of noise covariances based on said composite channel impulse responses,
 - (c) assigning a set of filter-tap locations by a sequential search,
 - (d) computing a set of filter coefficients for said set of filter-tap locations, and
 - (e) filtering said received signal with said set of filter-tap locations and said set of filter coefficients.
26. The method of claim 25, wherein recovering data in said received signal sent in a communications media is performed at a fractional oversampling rate.